Exhibit 9

McKinsey&Company

Advanced Industries

Connected car, automotive value chain unbound

Connected car, automotive value chain unbound

Contents

Executive summary

The term *"connected car"** is one of the most intensely debated buzzwords these days. There is no doubt that it will shape the future of the automotive industry, but how? Are consumers going to pay for it (and what is "it" anyway)? How will it impact the underlying revenue and profit pools? In addition, what will determine who will benefit from changes in automotive profit pools?

These are the questions we often hear from clients in the automotive, telecoms, technology, and insurance industries, among others, who are impacted by the connected car. We intend to address these questions in this report. We have conducted significant primary market research with 2,000 car buyers across four geographies (see text box 1) and have built a proprietary feature-level market model (see page 19) to separate fact from fiction and create a quantified understanding of value chain dynamics.

There are manifold definitions that are used when referring to the connected car. In this report, we include all use cases for passenger cars that build on processed information between vehicles and their environments. These use cases can be clustered along four relevant functional groups with particular relevance to passenger cars – each with its own value proposition, set of affected players, and projected evolution: in-car content and services, vehicle relationship management (VRM), insurance, and driving assistance. In regard to a timeframe, the report focuses on the upcoming years until 2020. Therefore, it includes several significant innovations but excludes the next potential revolution, which is likely to result from a massive rollout of (semi)autonomous vehicles.

As connectivity becomes an integral part of an automobile's value, companies from industries that may have seemed unrelated to the automotive industry just a few years ago will likely become key players. As a consequence, original equipment manufacturers (OEMs) and other traditional players may see shifts to their pieces of a pie that is getting more complex but not necessarily significantly bigger.

The global connected car market will grow, but overall car life cycle revenues are expected to remain stable.

To get a comprehensive view on the impact of the connected car, we need to consider the consumer's spend on a car in its entirety, the *life cycle value.* Based on a representative German D-segment vehicle, today's car life cycle revenue can be broken down into its vehicle price (52 percent), connectivity features and services (4 percent), maintenance (6 percent), insurance (14 percent), and operations (24 percent). By 2020, we expect the connectivity-related revenues share to increase moderately to approximately 7 percent in the European premium car segment. This amounts to a global market size of EUR 170 billion to 180 billion for car connectivity in 2020. However, we believe that this growth will be compensated by a base price decline, keeping life cycle spend more or less unchanged, just as it has remained since 1980.

Connectivity may trigger a significant redistribution of all major automotive revenue pools except car operations.

The impact on revenue pools indirectly affected by connectivity, such as vehicle price (through market share shifts) as well as insurance and maintenance, is much more significant than the connectivity revenue pool itself.

Vehicle price. On average, 20 percent of new car buyers state that they would switch to another car brand for better connectivity features. In some regions and for some segments this share is even larger, for example, up to 41 percent of drivers who spend more than 20 hours in the car per week. Hence, connectivity has the potential to shift significant market shares between OEMs. The emergence of third-party connectivity offerings such as the Open Automotive Alliance (OAA) and Apple CarPlay may level the playing field for infotainment and other software features among automotive OEMs.[1]

* Connected car or car connectivity comprises the set of functions and capabilities that digitally links automobiles to drivers, services, and other automobiles. The various features serve to optimize vehicle operation and maintenance as well as driver comfort and convenience.

Connectivity hardware. Higher rates of adoption will likely be offset by eroding feature prices, and OEM connectivity hardware revenues are at risk of being reduced or taken over by consumer electronics players.

Driver's time and attention. We expect an uptake of app- and content-related revenues to about EUR 750 over the life cycle, mainly through usage-based payment models. However, consumers will likely be loyal to their existing app/content ecosystems, thus limiting OEM participation to approximately 50 percent, even in an optimistic scenario.

Maintenance. Even after a typical 2-year warranty period, OEMs still capture a significant share of service and maintenance revenues. Using car condition data is an opportunity for OEMs to increase loyalty. At the same time, initial retrofit offers from third parties based on OBD-II dongles are already in the market. Today, 23 percent of new car buyers state that they would follow app recommendations for maintenance; this translates to a potential for the redistribution of about EUR 450 in life cycle maintenance revenues.

Insurance. Despite general privacy concerns, 35 percent of customers are already willing to trade driving data for insurance benefits. This creates an opportunity for OEMs to further tap into insurance revenue streams through their access to driving data as well as for others to do the same through the OBD-II interface.

The human-machine interface, car condition data, and dynamic real-time geoinformation will become the key control points in the redistribution of profits.

We believe that connectivity has the potential to fundamentally change the way in which profits are distributed in the automotive value chain. In understanding upcoming dynamics, we can derive learnings from industries that have gone through similar disruptions already, such as the mobile phone industry. For the mobile phone industry, the transition from feature phones to smart phones triggered a redistribution of profits from hardware to software, with the key determining success factors being the control of app stores and advertising platforms. We call these success factors control points. Applying this methodology to the automotive value chain, three major control points emerge:

Human-machine interface (HMI). While lagging OEMs can make a step change in improving their competitiveness by incorporating a third-party connectivity offering, leading OEMs will need alternative sources of differentiation in HMI, for example, even larger screens, multiple screens, innovative interface concepts, and large-scale augmented reality experiences.

Car condition data. Car condition data will be a key requirement for offering maintenance and insurance services. Although OEMs currently have privileged access to this data, third-party providers could convince consumers to install OBD-II dongles to create a superior user experience.

Dynamic real-time geoinformation. Due to the effort required to maintain granular map data, this market is increasingly becoming an oligopoly with only three major players on a global scale (TomTom, HERE, and Google). Access to granular map data will also become one of the critical enablers of (semi)autonomous driving.

Car connectivity will require fundamental changes to some of the core processes of automotive OEMs as well as new partnerships.

OEMs will need to adapt current processes and governance across functions, for example, further reduce R&D life cycle times for connectivity features (including over-the-air software updates for sold cars); build the big data IT-backbone unifying consumer accounts as the basis for connectivity offers; and digitize marketing and sales.

Moreover, a mindset shift from hardware make-or-buy decisions to software is essential when it comes to car connectivity. OEMs will have to carefully assess where to open up the car and provide platforms for third-party innovations such as apps. Also, industry standards or even data infrastructure partnerships for nondifferentiating layers (for example, high-detail and dynamic map data) would help OEMs lower their R&D investments and focus their efforts.

After 2020, (semi)autonomous driving will trigger the next wave of disruption with profound impact on the automotive industry.

On average, (semi)autonomous driving will free up one hour every day for drivers and, thus, further fuel connectivity-related business models, in particular with respect to media and content. Today, connectivity and advanced driver assistance systems (ADAS) further advance the development of (semi)autonomous driving (for example, via granular map data, regulation, customer acceptance) and therefore help set the stage for future adoption.

In general, these developments in the field of connectivity hold true on a global level; however, we also see significant regional differences in terms of customer needs and concerns.

While connectivity's trends seem to be consistent worldwide, there is great variation in the degree to which these trends take shape by region. For example, the idea that loyalty to a particular brand might be challenged by the availability of connectivity functionality is evidenced by the fact that up to 20 percent of consumers worldwide would be willing to switch car brands if an OEM offered an important feature exclusively. Looking at China alone, however, that share jumps to 41 percent.

The connected car trends are among the most shaping industry forces – with new players entering the competitive stage while incumbent OEMs and suppliers are trying to define, defend, and expand their competitive positions. Eventually, both regulation and consumer preferences will decide how these trends may play out and how they will impact the profit pools and the success factors for the participating players, automotive and nonautomotive players alike. Given the uncertainty of fast-moving technology, regulation, and consumer trends and forces, the findings derived from this research are themselves subject to permanent reviews and analytical scrutiny, to provide guidance for the players in the industry.

1 Connectivity is on the rise and companies are establishing their roles along its value chain

Today's car has the computing power of 20 modern PCs, features about 100 million lines of code, and processes up to 25 gigabytes of data per hour. As the computing capacity of cars develops further, not only is programming becoming more complex and processing speeds becoming faster, but the entire nature of the technology is shifting. While automotive digital technology once focused on optimizing the vehicle's internal functions, the computing evolution is now developing the car's ability to digitally connect with the outside world and enhance the in-car experience. This is the connected car – a vehicle able to optimize its own operation and maintenance as well as the convenience and comfort of its passengers using onboard sensors and Internet connectivity.

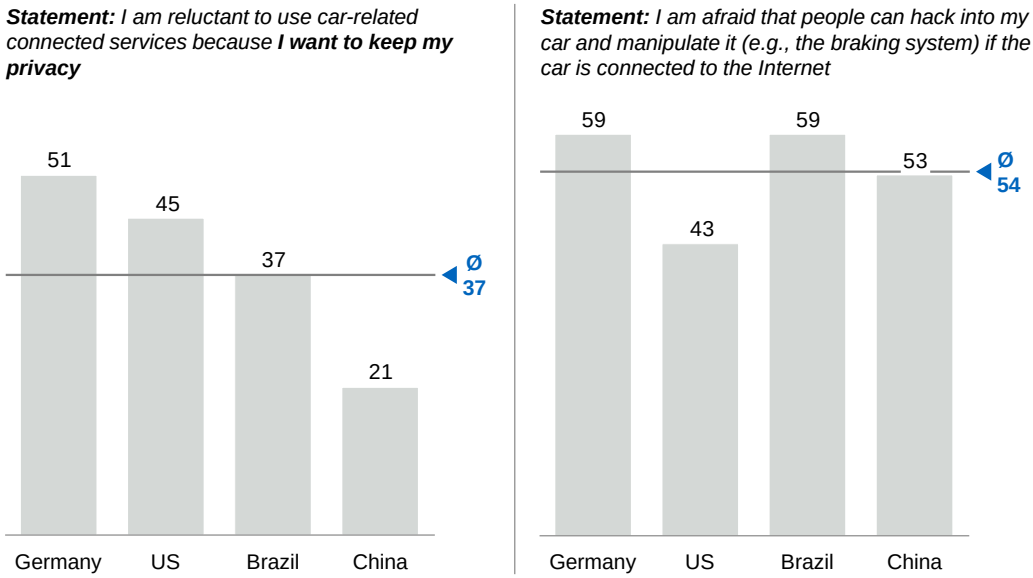
1.1 Consumers demand connected car features but also indicate privacy concerns and limited willingness to pay

According to the McKinsey Connected Car Consumer Survey 2014 (see text box 1), car connectivity features are a critical purchasing factor for more than half of new-car buyers, 28 percent of new car buyers prioritize car connectivity features over other features such as engine power or fuel efficiency, and 13 percent would not even buy a car that is not connected to the Internet today. However, at the same time, substantial hurdles remain for a quick and broad penetration of connectivity.

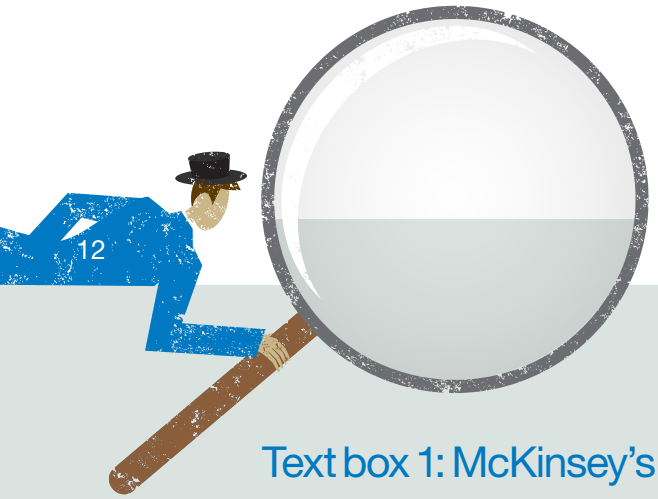
First, consumers are highly concerned about digital safety and data privacy issues of connected cars. 37 percent would even consider not using a connected car because of privacy concerns (Exhibit 1). Yet there are major regional differences. In Germany, consumers seem to be the most concerned by far – with 51 percent indicating that they are reluctant to use car-related connected services because of privacy issues. Consumers in China, however, seem to be a lot less concerned about data privacy – with only 21 percent indicating apprehension.

Exhibit 1: New-car buyers are broadly concerned about data privacy and the possibility of hacking when it comes to car connectivity

Percent of new-car buyers that (strongly) agree with the statement



SOURCE: McKinsey's Connected Car Consumer Survey 2014



Text box 1: McKinsey's Connected Car Consumer Survey 2014

In May 2014, McKinsey & Company conducted a consumer survey in four key automotive markets (US, Germany, China, Brazil) with a representative sample of 2,000 new-car buyers (500 per market), asking them about their current and expected connectivity needs and preferences. The goal of this survey was to better understand what consumers really think about connectivity in the car, what they like about it, what their concerns are, whether and to what extent they are willing to pay for connected car features, and how certain customer groups differ from others.

Based on the assessment of the consumer preferences of nine main connectivity features compiled over 36 indicators and complemented by 30 connectivity-related "attitude questions," McKinsey identified five distinct groups of new-car buyers who are distinctively different in terms of their purchasing preferences and attitudes and the factors that are part of their consideration sets (Exhibit 2). The three groups to watch – who together account for 56 percent of the representative sample – are the "maxed-out car enthusiasts," the "integration and entertainment lovers," and the "safe and secure navigators." Not only do these customers really appreciate connectivity features and are selectively willing to pay for them, but they tend to spend more money on a car and more time in a car than the average buyer. On the other hand, the "purists/minimalists" and "price-conscious traditionalists" indicate only very little interest and willingness to pay for car connectivity features.

Exhibit 2: About half of all new-car buyers are specifically interested in car connectivity

☐ Customer groups with higher interest in and willingness to pay for connectivity features

Segment	Preferences and attitudes	Ø willingness to switch for connectivity[1], %	Ø time in car hrs/week	Ø purchase price EUR '000	Segment share, %
Maxed-out car enthusiasts	▪ Prefer best connectivity features across the board ▪ Clearly want augmented reality navigation ▪ Always want to be connected to the Internet and stream media ▪ Depend on their smartphones a lot ▪ Only very little price sensitive up to EUR 1,800	31	11.3	33	25
Integration and entertainment lovers	▪ Always want to be connected to the Internet and stream media ▪ Really want their smartphone to integrate into the car ▪ Like advanced navigation features and Google/Apple services ▪ Prefer higher-end assistance sys, e-call, but no health monitoring ▪ Not too price sensitive up to EUR 1,200	27	11.6	26	15
Safe and secure navigators	▪ Broadly like assistance systems and health monitoring features ▪ Value remote services including vehicle tracking ▪ Prefer internal and car app navigation over external solutions ▪ Not too price sensitive up to EUR 1,200	19	9.2	26	16
Purists/ minimalists	▪ Do not indicate particular interest in any connectivity features ▪ Do not need to be always connected to the Internet ▪ Do not rely on smartphone ▪ Not too price sensitive up to EUR 1,200	11	8.4	22	28
Price-conscious traditionalists	▪ Do not indicate particular interest in any connectivity features ▪ Tend not to be comfortable with sharing their data ▪ Show high price sensitivity already at EUR 500	7	7.0	18	16
		▲ Ø 19	▲ Ø 9.5	▲ Ø 25	

1 Percent of new-car buyers that (strongly) agree with the statement: *I would switch from my current car manufacturer to some other manufacturers I trust if they would be the only ones offering a car with full access to the apps, data, and media on my type of phone (e.g., Android, iPhone)*

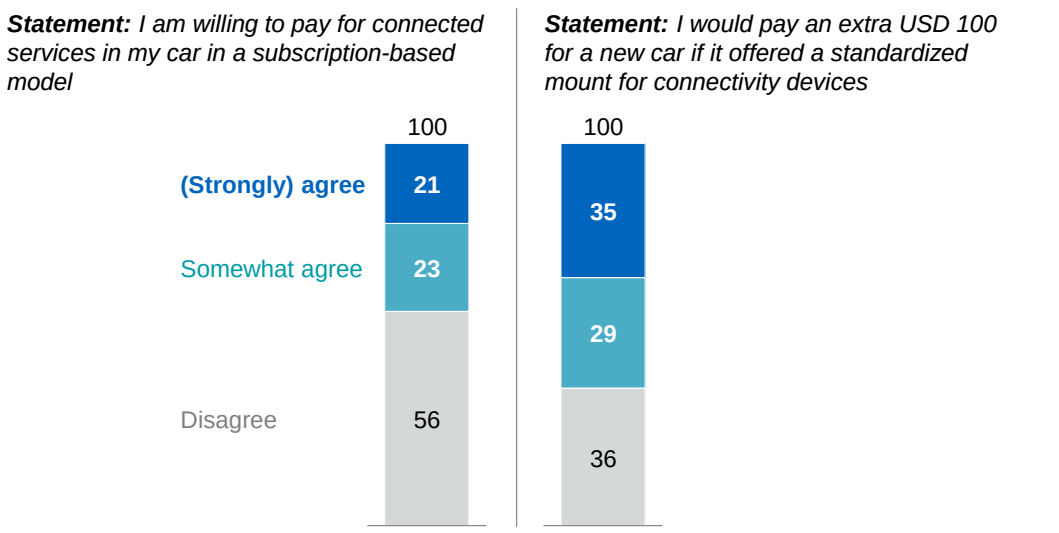
SOURCE: McKinsey Connected Car Consumer Survey 2014

Furthermore, 54 percent of new-car buyers in our survey are afraid of the possibility that hackers could manipulate their connected car and potentially cause an accident.

Second, consumers state a limited willingness to pay for car connectivity features (Exhibit 3). For example, only 35 percent of new-car buyers would spend an extra USD 100 for smartphone integration (a standardized mount for connectivity devices), and only 21 percent of consumers would be willing to pay for subscription-based connectivity services.

Exhibit 3: Consumers' willingness to pay is limited, even if standard connectivity devices would only cost as little as USD 100

Percent of new-car buyers, n (overall) = 1,917



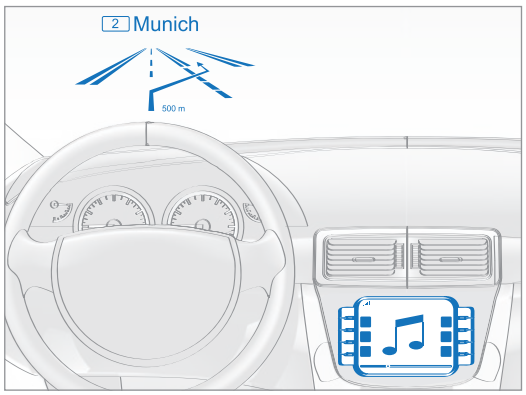
SOURCE: McKinsey's Connected Car Consumer Survey 2014

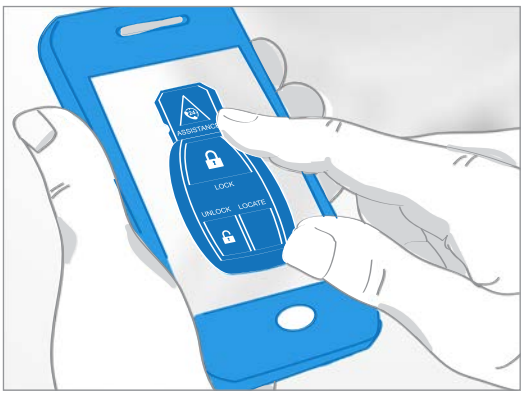
1.2 Cars are becoming increasingly "connected"

The number of connected features on cars is growing and in line with consumers' expectations. As the development cycle with cars (five to seven years) is longer than it is in software (often less than two years), however, connected car innovations are usually introduced step by step, often fueled by developments outside of the car industry. The emergence of the connected car will, thus, most likely not happen overnight but gradually, at least as long as a large part of the car park cannot get major software upgrades over the air.

Car connectivity comprises the set of functions and capabilities that digitally links automobiles to drivers, services, and other automobiles. The various features serve to optimize vehicle operation and maintenance as well as driver comfort and convenience.

Connectivity as a category has current or potential application to virtually all motor vehicle types and categories. In this report, we include all use cases for passenger cars that build on processed information between vehicles and their environments. These use cases can be clustered along four functional groups with particular relevance to passenger cars – each with its own value proposition, set of affected players, and projected evolution: in-car content and services, vehicle relationship management (VRM), insurance, and driving assistance. It should be noted, however, that B2B infrastructure services (for example, telematics-based fleet management) as well as commercial vehicles are not included in the scope (Exhibit 4).





In-car content and services. This includes seamless delivery of various content forms at any time. Today, this mostly comprises navigation systems, smartphone integration, and entertainment, but the functionality is expected to advance over the next few years. For example, Bluetooth connectivity currently makes for easier in-car voice conversations via smartphone. In the near future, smartphone apps will be more fully integrated, allowing drivers to, for example, have the day's scheduled events in their smartphone calendars displayed on the windshield. Cars will link user data such as calendar entries with other relevant information. For example, navigation systems will be able to automatically set a destination based on the address associated with the next appointment in the driver's calendar. Moreover, navigation systems that currently provide basic routing will likely predict traffic soon. Further down the road, navigation systems will be projecting onto the windshield, visible to the driver while he is driving and eliminating the need to look away from the road. Augmented reality will take navigation services even farther by overlaying real-world images with digital information at the appropriate place in the driver's field of vision, providing additional traffic information, including alerting the driver to imminent hazards.

Vehicle relationship management (VRM). Drivers are offered the double value of additional security through remote services and active maintenance through continuous monitoring. Remote services today allow drivers to lock and unlock their cars, but by 2020, GPS tracking and customized usage restriction could become standard remote VRM services. Current maintenance services include alerts when mechanical problems arise, while the more connected service of the future will likely deliver

Exhibit 4: Connectivity is changing the consumer experience step by step

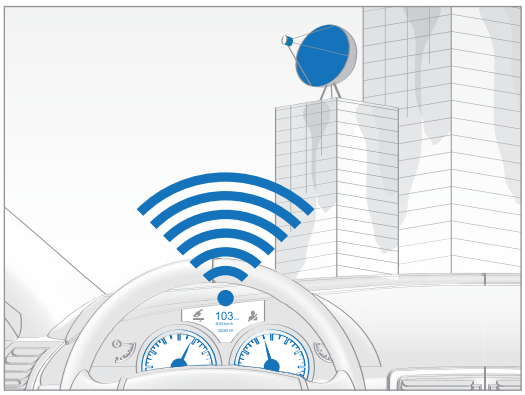
Use cases	"Standard" today (2014 - 17)	"Standard" 2020 (2017 - 20)
In-car content and services	**Navigation** (basic routing) — Built-in / External / Apps	**Navigation** (exchanges routing with smartphone for last-mile guidance)
	Phone integration/app access (touch screen controls)	**Phone integration/app access** (touch screen can mirror your smartphone screen)
	Entertainment (connectivity to MP3 player; e.g., iPod)	**Entertainment** (Internet access with music streaming)
		Call for help (automatic or manual e-call, b-call, crisis call)
Vehicle relationship management	**Remote services** (lock, horn, etc.)	**Remote services** (track stolen vehicle)
	Maintenance (maintenance alert and support, transfer of usage data)	**Maintenance** (remote diagnostics, prognostic service and maintenance alert)
Insurance	**Telematics-based tailored insurance tariffs** (pay-as-you-drive, pay-how-you-drive)	
Driving assistance	**ADAS[1]:** no automation (NHTSA level 0)	**ADAS[1]:** function-specific automation (NHTSA level 1)
Infrastructure services (B2B)	← Out of scope	

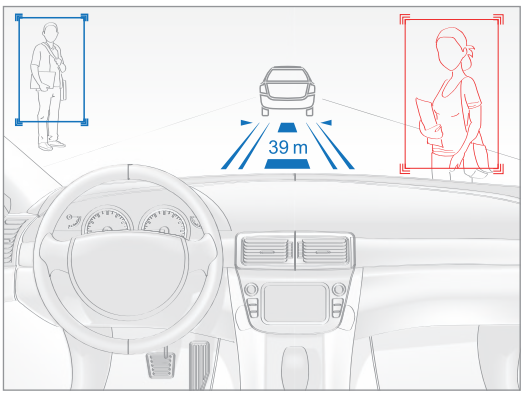
1 Advanced driver assistance systems
2 Advanced/future packages include all features of less advanced packages

SOURCE: McKinsey

Connected car, automotive value chain unbound

Connectivity is on the rise and companies are establishing their roles along its value chain

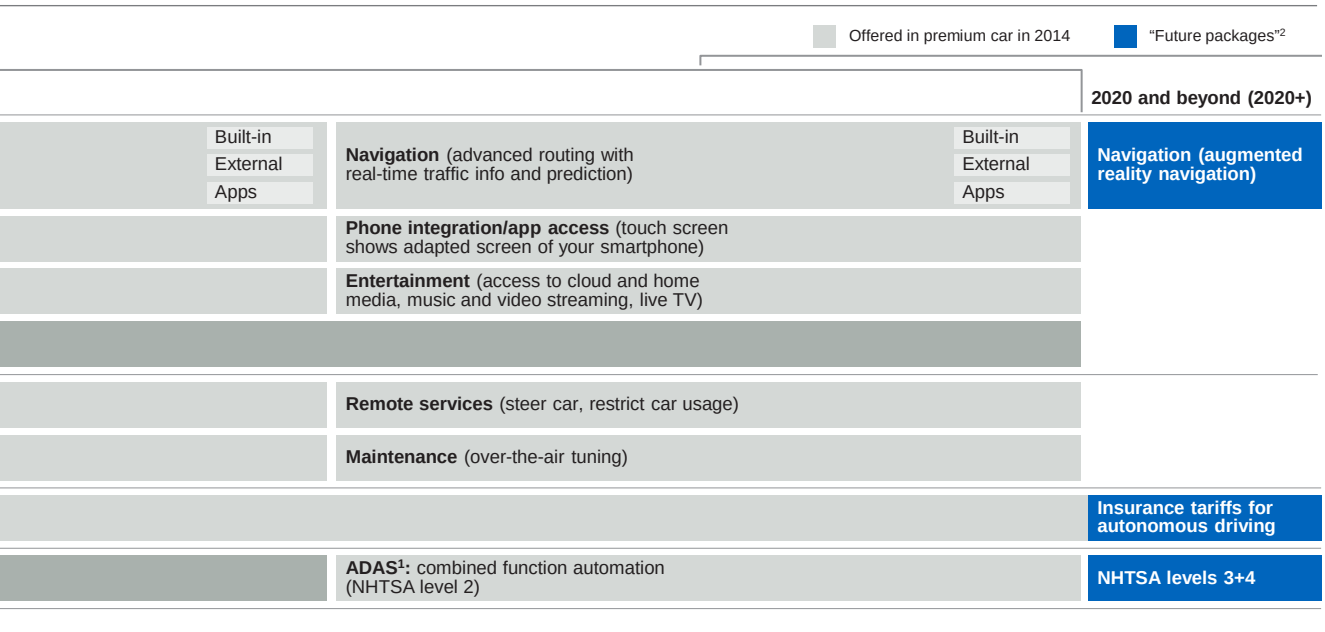




the capacity of an "over-the-air" tune-up as needed. Dealerships, OEMs, and service centers would all have a role to play as the connectivity of these services becomes increasingly sophisticated.

Insurance. Data regarding driving behavior is already stored onboard the vehicle to some extent, but greater connectivity will create an immediate feedback loop giving select third parties access to data such as driving speed, route, and time. This will significantly reduce the hurdle to offer telematics-based tailored tariffs like "pay-as-you-drive" and "pay-how-you-drive." Even with the need to install an external device in the car, telematics car insurance has started to gain a foothold, especially in the US.

Driving assistance. ADAS today make driving safer and more convenient with features such as blind spot object and pedestrian detection, lane assist, active city safety, active cruise control radar, collision warning with full auto brake, and active park assistance. These options are expected to become increasingly standard over the next six years. ADAS's longer-term evolution is predicted to be autonomous driving – adding even more value to the driving assistance value proposition (see Chapter 4). By removing human error from the equation, fully autonomous driving promises nearly 100 percent safety and greater commuting efficiency, allowing the person in the driver's seat to do whatever a passenger may want to do, including working, reading, watching video, or sleeping. Ultimately, autonomous driving will allow for the entire redesign of the human-machine interface (HMI) and interior layout of the car. As an example of this, Mitsubishi presented a concept car at the Tokyo Motor Show in 2013 that can transform its interior layout from "cockpit" to "office/entertainment" mode.[2]



1.3 Companies are repositioning themselves

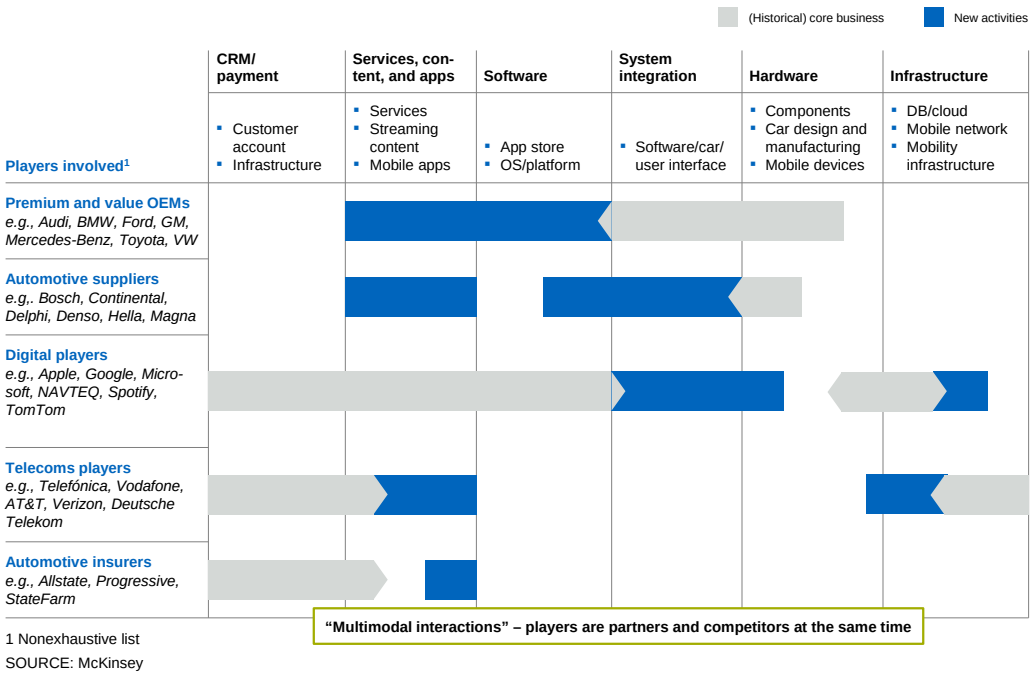
As the evolving connectivity of the car has profound effects on the automotive industry, top management teams of almost all OEMs and suppliers involved have made the connected car a top priority. This sentiment – captured in 2009 by the then Ford CEO Alan Mulally's description of the carmaker, "We are a car company, but we are learning how to think like an electronics company" – probably holds true for most OEMs already.[3] The connected car thus combines many effects observed in previous disruptions within the automotive industry, such as the emergence of in-car electronics, driver assistance systems or new powertrains, as well as those that have occurred in other industries, for example, the emergence of mass production and the breakup of vertical value chains. As a result, traditional players are repositioning themselves, and many new players are entering the arena, all trying to extend their current activities from different starting points (Exhibit 5).

For each of the five groups of players mentioned, specific strategy patterns are emerging in response to the wake of the connected car.

Premium and value OEMs are putting significant investments into the connected car and hope to capture a major share of new revenue streams. They are exploring ways to monetize the connected car by extending their activities from their core hardware business into the provisioning of a software operating system (OS) to serve as the platform for a potential app store, as well as into the development of specific apps and other services or media content. For example, Mercedes-Benz now offers its customers a broad range of connectivity services and products, including its "Mercedes me" online platform, and BMW's "ConnectedDrive" offers integrated infotainment, navigation, and safety features.[4] The relatively new market entrant Tesla sees connectivity as one of its key priorities and – not least because of its 17-inch built-in touch screens – has attracted a lot of attention for its digital customer experience.[5]

Automotive suppliers are trying to become less dependent on OEMs by establishing direct relationships with end customers. An example of this is

Exhibit 5: In recent years, traditional and nontraditional players are extending their activities from different starting points



1 Nonexhaustive list

SOURCE: McKinsey

Bosch's fun2drive app which allows customers to monitor relevant car functions and provides a direct connection to the nearest Bosch repair center.[6]

Digital players are entering the space by adapting their smartphone platforms to car-specific customer needs. Their objective is to expand the reach of their ecosystems and to integrate their infotainment OS and software platforms into the car systems and the human-machine interface of the car. Other players, such as media-streaming services or end-user equipment manufacturers, are also trying to gain a foothold. In particular, music-streaming services, such as Pandora, Spotify, and Deezer have already formed partnerships with selected automotive OEMs.[7]

Telecoms players have identified new opportunities in terms of infrastructure. Connected cars might actually unleash the next wave of growth for mobile operators. 36 million cars with preinstalled SIM cards are estimated to be sold worldwide in 2018. SBD research projects a potential revenue opportunity of EUR 4 billion for telecoms players globally as a consequence of this automotive-telecoms convergence.

Insurers also see unique opportunities in the evolution of the connected car. In the US, automobile insurers are already offering telematics-based coverage options. However, automobile insurers must also be aware of the risks of offering discounts associated with telematics and ADAS, including a potential revenue decline of up to 70 percent.

In addition to the types of players mentioned above, the emergence of the connected car also affects additional players such as semiconductor companies (for example, Intel, Nvidia, Qualcomm, ST Microelectronics) and end-user equipment manufacturers (for example, Samsung, Sony).

2 According to McKinsey's market model, the global connected car market is likely to grow

Connected car, automotive value chain unbound

According to McKinsey's market model, the global connected car market is likely to grow

McKinsey analyzed the connected car market and developed a market model to define the global automotive market for noncommercial light vehicles.

2.1 How McKinsey's Connected Car Market Model works

In regard to market model methodology, our projections take three elements into account: a set of core beliefs about connected car-related trends, a life cycle perspective, and scenarios that range from very optimistic to very pessimistic. The Appendix provides a brief overview of the methodology of McKinsey's Connected Car Market Model.

Core beliefs

Connectivity will become a significant and widely used feature. Having analyzed available industry and analyst reports, combined with our proprietary research, we have found there is consensus that by 2020, the vast majority (over 90 percent) of new cars sold will be connected cars. Even when estimating more conservatively, two-thirds of cars sold in 2020 are very likely to be connected.

New-car prices will stay more or less stable over time. This is based on proprietary research of net list development and an examination of the development of features of German premium vehicles over the last 20 years. Analysis shows that features that used to cost extra in the past have become standard and are included in future car base prices, so that technological development does not increase base prices in the long term.

Every connected car will have its own connection to the cloud. This means that cars will not depend on other external/mobile devices such as tethered smartphones for connectivity.

Life cycle perspective

Unlike analyses that define revenues as a share of the net list price on the day of purchase, we take a vehicle life cycle perspective, looking at what a customer spends on a car over a 5-year life cycle. This allows us to account for recurring revenues from connectivity features, for example, subscription fees or in-app purchases. To offer a comprehensive view on the impact of car connectivity, we not only look at the car and its features, but we consider the entire life cycle of the connected car from the customer's point of view. Thus, we also take into account newly emerging subscription-based contents and services, as well as the effects of connectivity on important revenue streams, such as maintenance and repair, operations (fuel, etc.), and insurance.

Business case scenarios

For illustration purposes, we defined a realistic base case scenario as a reference point. However, it should be noted that market development and future industry dynamics depend on a broad range of critical factors. Hence, we calculated different scenarios in our market model, which range from very optimistic to very pessimistic.

In the most optimistic case from an OEM perspective, carmakers keep full control, connectivity opens exclusive access to new revenue and profit streams for existing automotive players along the whole vehicle life cycle, and connectivity extends user experience within the car and becomes an additional differentiating factor for OEMs. Moreover, positive factors include the ability to increase prices on new features – for example, semiautonomous driving – customers' willingness to pay for new services, and higher penetration rates of connectivity features in entry segments.

In the most pessimistic case from an OEM perspective, Silicon Valley gains significant control, industry profits shift towards software- and service-based business models, cars become one among many commoditized devices, and OEMs lose their brand appeal and core value proposition. Furthermore, negative factors include even stronger price declines of connectivity components or the expectation that these components will be standard features, for example, driven by stronger competition from new players, replacement of car connectivity components by consumer devices such as smartphones, and lower penetration rates in entry segments.

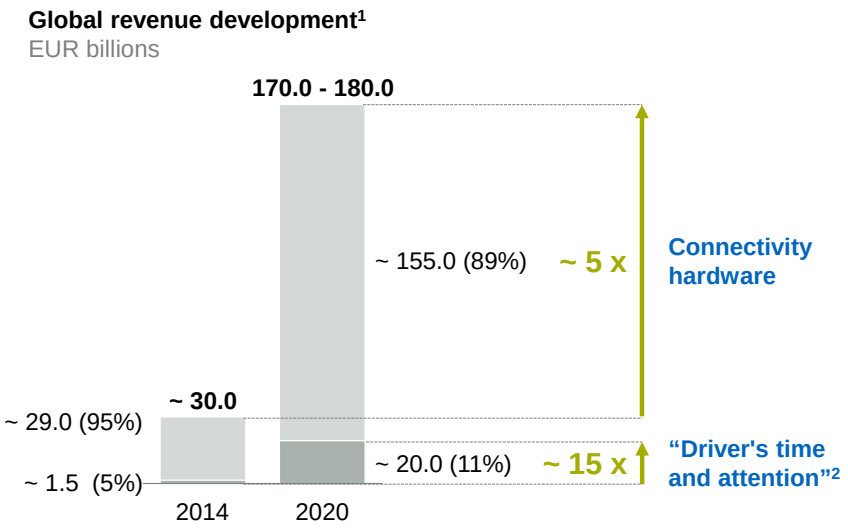
2.2 Global connected car market revenues are likely to increase sixfold by 2020

According to our base case scenario, global annual industry revenues from connectivity are expected to increase sixfold from approximately EUR 30 billion in 2014 to approximately EUR 170 billion to 180 billion in 2020 (Exhibit 6). Upfront connectivity hardware revenues are expected to remain the single largest source of revenues globally. However, increasing connectivity will also trigger a shift towards recurring and usage-based revenues from software and services on which drivers spend their time and attention – such as navigation updates or media streaming, accounting for a quarter of the industry revenues in 2020.

It should be noted, however, that the market development depends on a broad range of critical factors which may significantly increase or decrease the global revenue forecast. Factors that may raise the forecast include the ability to increase prices on new factors, e.g., semiautonomous driving, consumers' willingness to pay for new services, and higher penetration rates in entry segments. Factors that may lower the forecast include the possibility that connectivity components suffer even stronger price declines, e.g., driven by stronger competition from new players, the chance that consumer devices replace car components, and lower penetration rates in entry segments.

Exhibit 6: Global connected car market is expected to grow strongly, and revenue distribution will shift more towards usage-based models

Annual industry revenues from car connectivity — BASE CASE



1 No inflation assumed (all values in 2014 EUR), dealer margins included, local sales taxes excluded
2 Includes all revenues from usage-based software/services

SOURCE: McKinsey

2.3 Overall car life cycle revenues are expected to remain stable

The future of a car's value is more complex than what the expected spike in connectivity-related revenues might suggest. In addition to connectivity's share of overall customer spend, automotive players will need to consider developments to the other components of the car's life cycle value as well as projections regarding overall vehicle price.

Components of car life cycle revenues

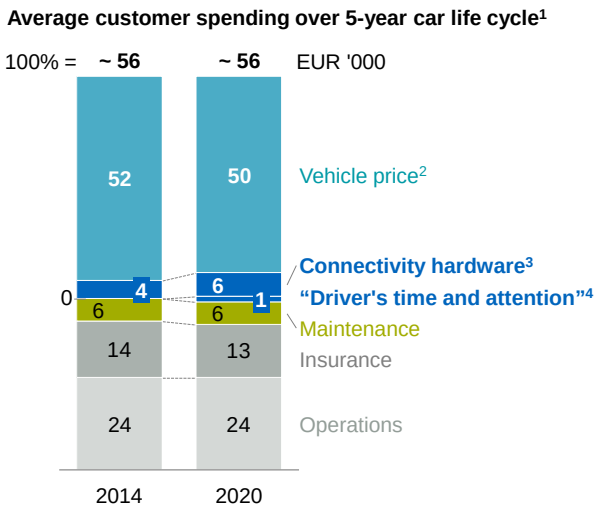
As Exhibit 7 illustrates for a premium segment vehicle in Germany, consumer spend over a car's life cycle today is split into its vehicle price (52 percent), connectivity features and services (4 percent), maintenance (6 percent), insurance (14 percent), and operations (24 percent). Accordingly, what the customer pays for a new car on the day of purchase (excluding connectivity hardware and "driver's time and attention" costs) only accounts for approximately 52 percent of what the customer spends on the car over an average 5-year life cycle. For example, a representative premium car owner in Germany spends approximately EUR 31,800 at purchase, including the vehicle price and connectivity features (such as navigation, phone integration, entertainment, and remote services) and ADAS features (such as lane/park assistance or advanced cruise control). On top of that, the average car owner will spend another EUR 24,800 over the car's life cycle, including the cost of operations (fuel, oil, and car wash), insurance premiums (liability and comprehensive coverage), maintenance and repairs, and connectivity services.

Going forward, we expect connectivity-related revenues to remain a small portion of total customer spend and to increase their share only moderately to approximately 7 percent in a premium segment vehicle in Germany as increasing adoption rates are partially offset by declining prices. Accordingly, 6 percent will be based on connectivity hardware while less than 1 percent will be based on "driver's time and attention." OEMs will have to balance connectivity content with other partly even mandated content such as powertrain-related components that improve fuel efficiency.

Exhibit 7: From a car life cycle perspective, connectivity captures a small share, while overall revenues remain stable

Percent of representative D-segment premium vehicle, Germany

BASE CASE



1 Life cycle revenues 2014 - 19 and 2020 - 25, no inflation assumed (all values in 2014 EUR), dealer margins included, local sales taxes excluded
2 Based on average configuration price of vehicle excluding connectivity hardware and "driver's time and attention" revenues
3 E.g., navigation system, entertainment package hardware, ADAS hardware
4 Includes all revenues from usage-based software/services

SOURCE: McKinsey

Continued stagnation of car life cycle revenues

Our analysis reveals that total car life cycle spend has been constant in real Euros since 1980 due to slowly decreasing base prices and the slow shift of features to standard equipment. For example, our findings lead us to believe that smartphone integration – enabling control of the smartphone via the car's HMI and a mirroring of the smartphone display onto the car display, as well as access to native in-car applications that focus on car-related functions – will be in wide use in the premium segment by 2020 even though this technology is virtually nonexistent in most cars today. Moreover, prices for navigation systems and remote services with today's feature set are expected to decline.

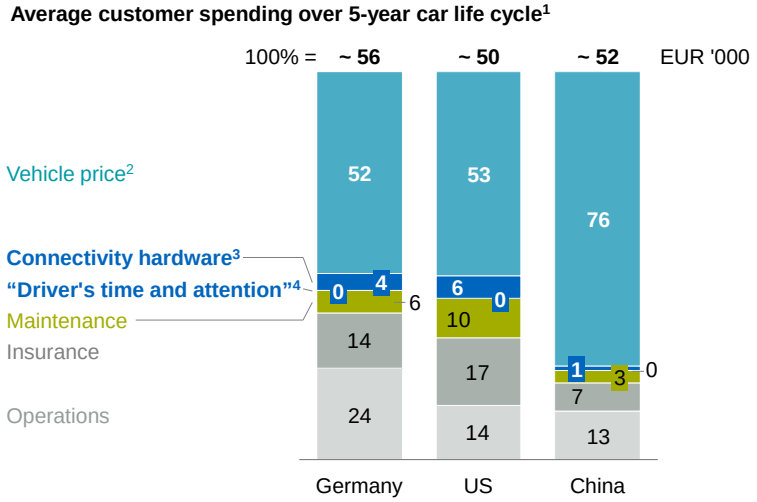
However, OEMs might succeed in maintaining or even increasing today's price points through truly differentiating features and services, both in the product offerings and in the after-sales services.

When we compare total cost of ownership across countries, we can identify similarities between the German and the US markets (Exhibit 8). The Chinese market differs, e.g., premium vehicles are currently priced higher than in Europe or the US. Additionally, the Chinese after-sales market (including maintenance and insurance) is currently underdeveloped, and thus we project strong growth (20 percent p.a.).

Exhibit 8: A life cycle comparison across countries reveals similarities between the German and US connectivity markets, while China differs slightly

Percent of representative D-segment premium vehicle, 2014

BASE CASE



1 Life cycle revenues 2014 - 19 and 2020 - 25, no inflation assumed (all values in 2014 EUR), dealer margins included, local sales taxes excluded
2 Based on average configuration price of vehicle excluding connectivity hardware and "driver's time and attention" revenues
3 E.g., navigation system, entertainment package hardware, ADAS hardware
4 Includes all revenues from usage-based software/services

SOURCE: McKinsey

3 Car connectivity is expected to trigger a redistribution of the five most important automotive revenue pools

Connected car, automotive value chain unbound

Car connectivity is expected to trigger a redistribution of the five most important automotive revenue pools

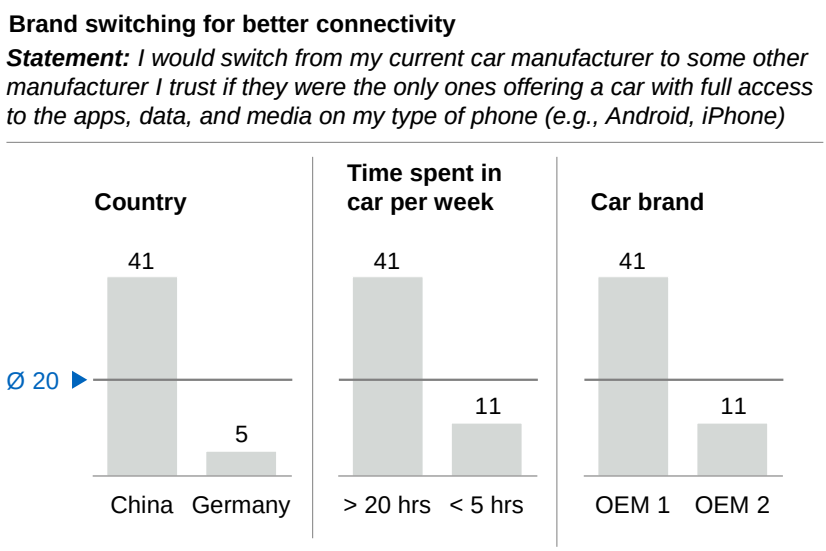
Connectivity revenues may only account for a small share of the total customer life cycle spend by 2020, but connectivity has the potential to trigger a significant redistribution of revenues along five major automotive revenue pools: vehicle price, connectivity hardware, "driver's time and attention," maintenance, and insurance. As for the sixth pool, operations, we do not anticipate significant effects beyond technical connectivity-based improvements such as fuel savings.

3.1 Vehicle price – connectivity has the potential to shift market shares between OEMs

Connectivity will likely become a "must-have" feature. The entry of IT players (for example, through OAA and Apple CarPlay) into the automotive industry may level the playing field for infotainment and other software features.[8] Our consumer research reveals that already 20 percent of all new-car buyers would switch car brands for better connectivity features (Exhibit 9). For selected consumer groups, connectivity is an even more important purchasing factor. For example, 41 percent of the "frequent travelers" (that is, consumers who spend more than 20 hours per week in the car) would switch.

Exhibit 9: 20% of new-car buyers would switch car brands for better connectivity – and for certain consumer groups, connectivity is even more important

Percent of new-car buyers who (strongly) agree with the statement



SOURCE: McKinsey's Connected Car Consumer Survey 2014

3.2 Connectivity hardware – OEM revenues may be at risk of being reduced or taken over by consumer electronics players

In 2020, on average 6 percent of a car's life cycle revenue* can be expected to stem from connectivity-related hardware, accounting for a total of about EUR 3,500 of upfront revenues per car (Exhibit 10). This life cycle revenue bucket can be broken down into five distinct areas of connectivity: navigation systems, phone integration/app access, entertainment, remote services, and ADAS.

According to our estimates, the sale of built-in navigation systems will bring in about EUR 1,440 in revenues per car in 2020, accounting for almost half of total connectivity-related hardware revenues. Despite increasing adoption rates, we believe that revenues from built-in navigation will stall as price erosion for today's feature sets continues. Features already available for navigation systems will most likely become standard equipment by 2020, thus leaving OEMs unable to monetize them. New technology, however, might still be sold at premium price levels. For instance, OEMs can expect to retain high-level revenues from navigation systems if they continue to improve the integration of features into the overall user experience combined with superior (interface) hardware and state-of-the-art feature sets.

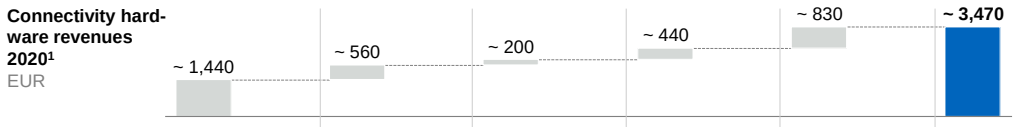
The second largest bucket in terms of revenues consists of ADAS. These features will see strong growth and proliferation until 2020. However, especially in the premium segment, they will also be affected by price erosion. Historically, safety/security features have been included in premium cars' standard equipment along with their rising success, and we expect the same to hold true going forward. Thus, the overall increase in absolute revenue per car will be moderate at about EUR 350 and mostly driven by further increase of take rates. Yet despite only moderate overall growth in hardware revenues, OEMs need to

* All figures in this chapter relate to a German D-segment premium car

Exhibit 10: Upfront connectivity hardware revenues will see only moderate growth and account for ~ EUR 3,500 in 2020

Representative D-segment premium vehicle, Germany

BASE CASE



	Navigation	Smartphone integration/ app access	Entertainment	Remote services	ADAS	Total
Description/ assumptions 2020	▪ Built-in navigation system ▪ Real-time traffic info and prediction ▪ Advanced car integration	▪ In-car app access ▪ Full smartphone integration	▪ Large screens and integrated user interface ▪ Music/video streaming ▪ Access to home media	▪ Restricted car usage ▪ Car steering via mobile, e.g., parking	▪ Adaptive cruise control ▪ Emergency breaking ▪ Active lane assist	
Delta 2014 - 20 EUR	**+20**	**+310**	**+160**	**-140**	**+350**	

1 Life cycle revenues 2020 - 25, no inflation assumed (all values in 2014 EUR), dealer margins included, local sales taxes excluded

SOURCE: McKinsey

take a strategic approach to ADAS. Whereas the integration of user devices and seamless entertainment and streaming experiences can simply be seen as "must-have" features, OEMs should view ADAS as an essential asset on the critical path to (semi)autonomous driving.

Seamless integration of smartphones and other portable devices – along with full in-car access to apps both installed on user devices as well as directly on cars' operating systems – will form the third-largest revenue bucket. Here, we expect built-in car apps to focus primarily on car-related functions, while the seamless integration of user devices will provide access to the app universe.

A strong proliferation of solutions in the premium segment is to be expected by 2020. In particular, the functionality promises of third-party offerings such as Apple CarPlay or MirrorLink will likely leave OEMs unable to charge a price premium for them and might even trigger a drastic price drop if one of the digital players decided to provide their platform for free.[9] Sales of entertainment features, including access to home and cloud media, will see solid growth from increasing take rates as well, while revenues for remote services are likely to fall in absolute terms as price erosion will overcompensate gains from increased penetration for these features.

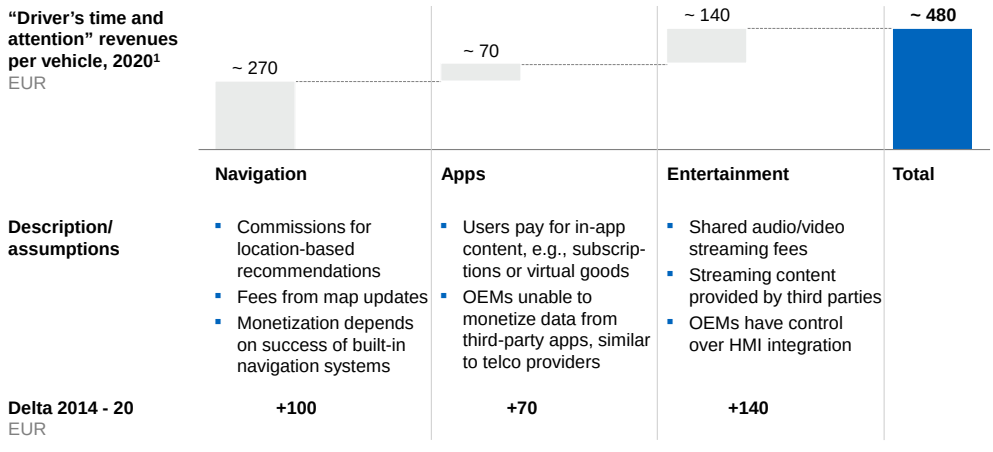
3.3 Driver's time and attention – OEMs will likely need to secure their share of usage-based revenues

We believe the upside for OEMs from usage-based revenues to be limited to about EUR 500 per car. Given changing customer demands, however, OEMs still need to integrate these features into their cars to remain competitive (Exhibit 11).

Exhibit 11: Future usage-based revenue potential is limited – in a base case scenario, only ~ EUR 500 per car are expected

Representative D-segment premium vehicle, Germany

BASE CASE



1 Life cycle revenues 2020 - 25, no inflation assumed (all values in 2014 EUR), dealer margins included, local sales taxes excluded

SOURCE: McKinsey

About half of these usage-based revenues will likely stem from navigation. If OEMs succeed in selling their built-in navigation systems and are not cannibalized by third-party navigation apps, we expect the monetization of services such as location-based recommendations which might offset today's revenues from offline map updates, e.g., via DVD. Also the nature of map updates will likely shift from annual DVD releases to hybrid online and offline maps with automatic over-the-air updates for offline data.

Furthermore, we do not see commercial success in paid navigation apps, as every smartphone is preloaded with a free maps application from, for example, Apple, Google, Windows, or Waze – which today already provide many advanced navigation features, such as crowd-based traffic information and routing or location-based recommendations. The majority of additional revenue from in-app content, for example, subscriptions or virtual goods, will thus remain in the respective app ecosystem, being shared by the app developer and the platform provider. The same will hold true for streaming fees from audio and video content delivery. Here, OEMs may be able to exert a certain degree of control over the HMI integration, thus gaining up to 30 percent of the revenues.

3.4 Maintenance – OEMs may have an opportunity to increase after-sales loyalty

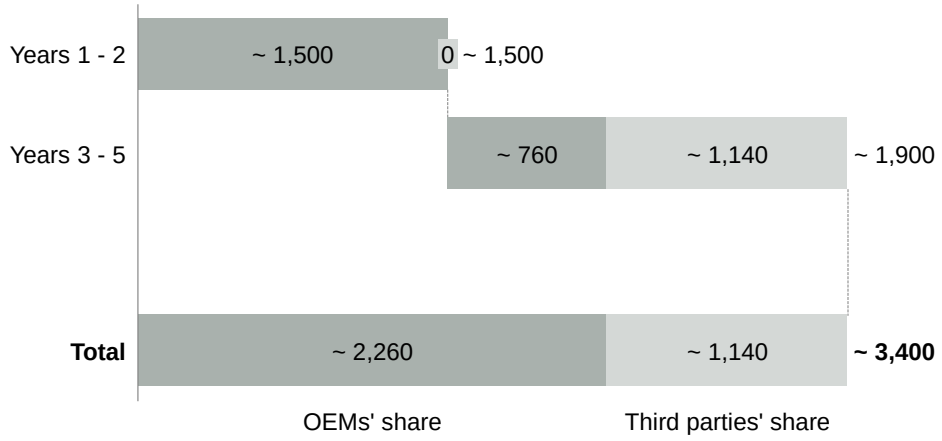
Our consumer research shows that 23 percent of new-car buyers state that they would potentially follow a maintenance app recommendation, which translates to EUR 450 revenue redistribution to the best recommendation solution. Moreover, utilizing car condition data is an opportunity for OEMs to increase loyalty. At the same time, initial retrofit offers from third parties based on OBD-II

Exhibit 12: Willingness to follow maintenance app recommendations could lead to a shift in post-warranty revenue distribution

EUR for representative D-segment premium vehicle, Germany

BASE CASE

Average maintenance spending over 5-year car life cycle[1]



1 Life cycle revenues 2020 - 25, no inflation assumed (all values in 2014 EUR), dealer margins included, local sales taxes excluded

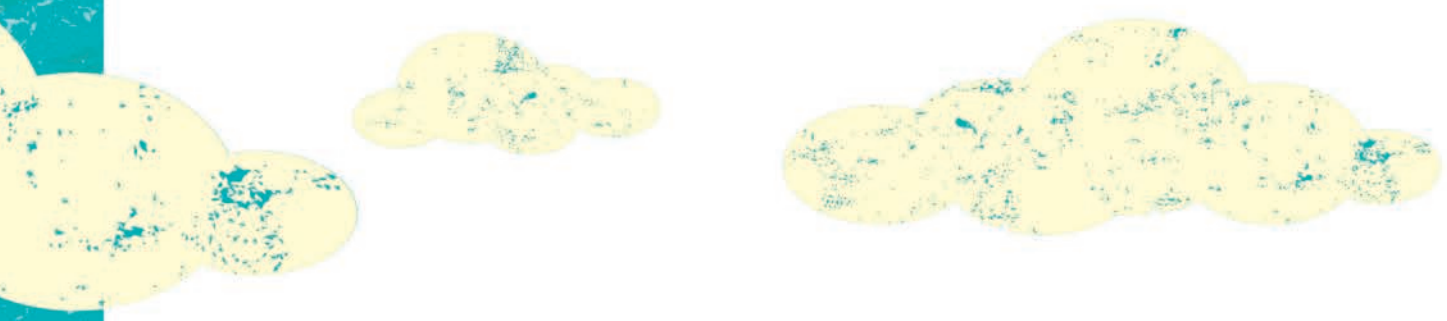
SOURCE: ADAC; DAT Report 2014; McKinsey's Connected Car Consumer Survey 2014

dongles are in the market already. Regarding the current maintenance and repairs spend over the life cycle of a car, the average customer spends EUR 3,400 (Exhibit 12). While the first two years are typically covered by the OEM warranty, servicing from years three to five is competitive with approximately 60 percent of maintenance revenues today, that is, EUR 1,140, captured by third-party service shops.

3.5 Insurance – as data and technology providers, OEMs may collect their share of telematics-based insurance discounts

Although general digital safety and privacy concerns remain widespread, 35 percent of consumers are willing to trade driving data for an insurance rate discount of 10 percent. US car insurers already offer discounts of up to 30 percent based on individual driving telematics data. We believe this first wave of telematics-based discounts will lead to a lower standard premium level by 2020 – quickly to be followed by further potential discounts triggered by the availability of ADAS features for (semi)autonomous driving. This creates opportunities to tap into insurance revenue streams for OEMs through their access to driving data as well as for other players through their access to the OBD-II interface. As data and technology providers, OEMs will attempt to collect their share of these discounts for enabling telematics-based insurance tariffs, provided local regulations allow it.

4 Ability to monetize profit pools will depend on control points



We believe that ownership of a number of control points – the hardware and software that give drivers, passengers, or other parties access to a car's features or to the data gathered about its operation – will determine the future distribution of revenues and profits. Industry players may regard control points as enablers, and they need to define their ultimate distinctive sets of connectivity offerings which can be features or services or both. In this regard, it may also be crucial to probe and experiment with innovative ideas, possibly through cooperations with external providers as well as through preferred partnerships or ecosystems.

4.1 Delivery models and technology choices will significantly influence the distribution of future profit pools

We have identified a total of 12 potential control points in the following three areas: inside the car, connection to the cloud, and data cloud (Exhibit 13):

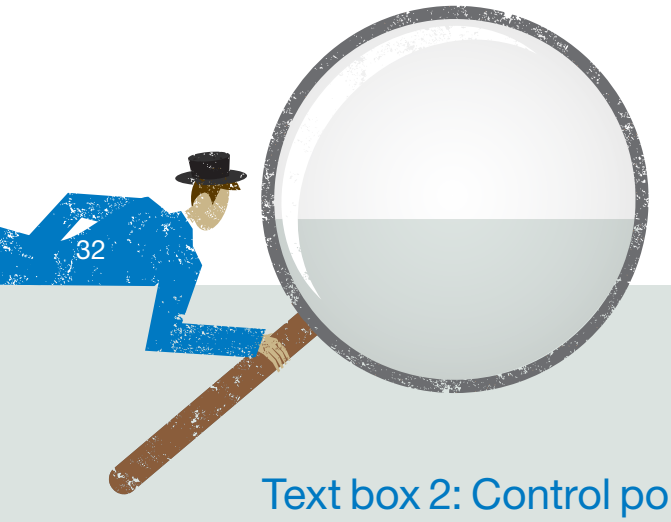
Exhibit 13: Overview of control points

Area	Potential control points
Inside the car	Human-machine interface (HMI)
	Apps/content
	App store
	In-vehicle infotainment (IVI) operating system
	CPU and control unit
	Car position data
	Car sensor data
	Car actuators
Connection to the cloud	Mobile connection
Data cloud	Data gateway
	Granular map data
	Dynamic real-time geospatial information

Inside the car. The most obvious control point is the *HMI.* Whoever controls buttons, knobs, and touch pads can massively influence the in-car user experience for driving, audio, and video. Currently, this control point is owned by carmakers, yet other players, for example, tablet manufacturers such as Apple, are making a play for it.[10] Hence, there may be opportunities for differentiation in self-guided software interfaces. Two control points are centered on future in-car applications, where *apps* as the actual *content* offering can be distinguished from the *app store* as the platform – and it is still uncertain who will own these control points in the future. While several OEMs are developing proprietary platforms and applications, Google and Apple seek to establish their mobile solutions in the automotive space. The *IVI operating system* is also crucial for an exceptional customer experience. Here, Blackberry's QNX currently is the market leader with about 50 percent market share, but the competition from Windows Embedded Automotive, GENIVI-compliant Linux-based solutions and an Android platform supported by the OAA is steadily increasing.[11] Moreover, the *CPU/control unit* processes car data, such as *car position data* based on GPS and radio frequency or *car sensor data* like throttle position, oil, light, speed, rpm, and rain sensors. Moreover, *car actuators* for braking or steering, for example, are also part of the control points inside the car which are all owned by the OEM as of today.

Connection to the cloud. Cars will increasingly feature embedded SIM cards or other technologies for *mobile connection* providing a constant link to the Internet. As connectivity services will – by definition – require Internet connection, the quality of the "data pipe" will be critical for customer experience.

Data cloud. Finally, we think that the data cloud will also exert influence on the connected car and the revenues that come with it along three control points. The car's *data gateway* needs to address digital safety and privacy concerns and meet the highest standards for data safety/encryption of connectivity features and services. Moreover, sophisticated connectivity services, namely navigation, will require high-quality *granular map data* and *dynamic real-time geospatial information,* for example, for hazard warnings and traffic updates.



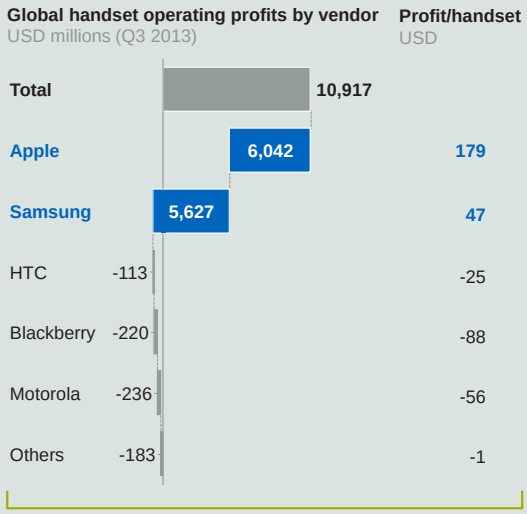
Text box 2: Control points in the telecommunications industry

In industries with more advanced connectivity, profits are concentrated with players that have established ownership of critical control points in the ecosystem. Using the example of the telecommunications industry, one can learn how quickly revenue streams may shift towards services/content providers with all but a few players losing money from selling handsets. As of 2013, Apple and Samsung were the only companies able to sell handsets at a profit, essentially capturing all industry profits, whereas other players (HTC, Blackberry, Motorola, etc.) sold their devices at a loss. With about USD 180, Apple has by far the highest profit per handset, more than three times that of Samsung. Among other factors, this can be attributed to Apple owning an operating system and app store and offering a seamless service ecosystem in addition to its handsets, thus realizing significant price premiums.

In addition, new players like Google and Amazon have been able to introduce new business models, successfully monetizing services and advertisements by owning critical control points. Google, for example, makes a USD 3.40 profit on average per Android device per year from mobile advertisements due to the fact that it controls the operating system, the app store, and the ad platform (Exhibit 14).

Exhibit 14: Telecommunications industry shows how profit shifts towards services/content, with all but a few players losing money from hardware sale

Consumer electronics business models show importance of control points



Most players losing money despite global handset revenue increase of over 80% from 2009 to 2013

Profitable players	Key control points
Apple By far highest profit per handset with USD 179 per device	▪ **Device/HMI** (superior design) ▪ **OS** (iOS) ▪ **App store** (Apple App Store)
Google Realizes USD 3.4 profit from mobile ads per Android device	▪ **Apps** (generating customer data) ▪ **OS** (Android) ▪ **App store** (Google Play)
Other example: **Amazon** USD 41 in revenues per Kindle Fire tablet with advertising and services	▪ **Apps** (media focus) ▪ **Modified App store** (Amazon App Shop) ▪ **Media store**

Owning key control points is critical to being profitable

SOURCE: Consumer Intelligence Partner Reseach; McKinsey iConsumer Survey USA 2013; Piper Jaffray

4.2 OEMs should focus on a set of key "differentiators" instead of competing for all control points at once

Control points will provide different levels of perceived customer value depending on each OEM's current scale, brand positioning, and target markets (see text box 2). Overall, we analyzed all control points along customer relevance, OEM investment requirement, and OEM competency. We then categorized the control points as either "must-haves" or "differentiators" (Exhibit 15).

"Must-have" control points

These are the connectivity features and services perceived by customers as necessary. Since customers expect their cars to have connectivity features and are even willing to switch brands to get them, OEMs will need to provide them in order to stay competitive in the market. These "must-have" control points require high investments for proprietary solutions, are very difficult (but necessary) arenas for OEMs to compete in against IT giants with an economies of scale advantage, have limited differentiation potential for "commodity" features, and/or lack OEM competency. In addition, most "must-have" control points can likely be sourced from third parties and/or codeveloped with partners. Regarding apps/content, customers expect OEMs to offer the most popular apps for their cars, and OEMs need to deliver. For the control points app store, IVI OS, and CPU/control unit, OEMs should ensure user friendliness and reliability, as customers are already used to a high level of comfort and sophistication from their smartphones. Regarding the mobile connection and data gateway control points, OEMs must offer appropriate speed of data transfer and guarantee data security as customers are concerned about data privacy and safety issues, for example, the ability of hackers to cause car accidents.

Exhibit 15: OEMs will need to focus on a set of key "differentiators" to compete successfully

Area	Potential control points	Strategic assessment	Rationale
Inside the car	HMI	**Differentiator**	▪ Key for customer experience and branding
	Apps/content	"Must-have" features (via sourcing/partnering)	▪ High investments for proprietary solution ▪ Difficult to compete against IT giants ▪ Difficult to reach economies of scale
	App store		
	IVI[1] OS		
	CPU/control unit		
	Car position data		
	Car sensor data	**Differentiator**	▪ OEM core competency ▪ Key for ADAS features
	Car actuators		
Connection to the cloud	Mobile connection	"Must-have" features (via sourcing/partnering)	▪ High investments for proprietary solution ▪ Limited differentiation potential for "commodity" features ▪ Limited competency
Data cloud	Data gateway		
	Granular map data		
	Dynamic, real-time geospatial information	**Differentiator**	▪ Key for ADAS features ▪ Potential competitive advantage

1 In-vehicle infotainment

SOURCE: McKinsey

Differentiating factors

On the other hand, these are generally more critical in the coming battle for the new connectivity-oriented customer segments. OEMs need to focus on these control points to potentially win over additional market share. Potential differentiators include the HMI, car sensors and actuators, and dynamic real-time geoinformation.

Human-machine interface (HMI). While lagging OEMs can make a step change in their competitiveness through partnerships with IT or consumer electronics players, leading OEMs will need alternative sources of differentiation in HMI, for example, augmented reality on much larger head-up displays than those featured today. HMI systems need to contend with the increasing complexity and a rapid rise of the number of applications. How OEMs design their respective HMIs to be safe to use, intuitive, and user friendly as well as enhance the comfort of the vehicle and its occupants will be a key differentiating factor across brands. OEMs have already started to incorporate different technologies into their HMIs such as touch screens, voice and gesture recognition, head-up displays, and augmented reality. With the deployment of autonomous driving, new degrees of freedom can be tapped by OEMs to even further differentiate their in-car experiences from those of their competition.

Car sensor data and actuators. OEMs are well positioned to introduce innovative pay-as-you-drive insurance and predictive maintenance offers based on their privileged access to car sensor data. Other players can gain access through the OBD-II port but need to convince customers to install a dongle. Car sensors and actuators can enhance the functionality of the vehicle and provide differentiating functions for the customer, for example, by enabling advanced ADAS features, monitoring the attention and health status of the driver as well as allowing remote control and theft protection. Furthermore, advanced sensors and actuators are key technological requirements and offer significant differentiating potential for (semi)autonomous driving.

Dynamic real-time geoinformation. Dynamic real-time information is pivotal for providing superior navigation and location-based services, for example, real-time traffic information, optimized routing, and “bonus-as-you-drive-by” business models (where retailers offer bonuses/discounts to drivers who agree to drive by their stores while in-car advertisements are broadcasted). This information is also a key requirement for the realization of (semi)autonomous driving.

5 OEMs need to adapt across functions and consider new partnerships

We are currently witnessing how three of the most important breakthrough inventions of the 20th century, the car, the computer and the Internet, form a dynamic trio. Together, they will not only have an effect on the car itself, but also transform the organizations that design, engineer, assemble, and sell it and the way value is delivered to the customer (see text box 3).

Whereas OEMs traditionally tend to follow a 5- to 7-year development cycle, major software releases are usually delivered every one to two years, with many cloud-based services updated on a continuous basis. While cars go through lengthy technical and regulatory approval processes, software services in the cloud are often tested on the fly, sometimes with multiple versions online at once. We expect the automotive industry to move towards this trend, which will have major implications for processes and governance across functions, from R&D and production via the supply chain to sales, marketing, and after-sales services.

5.1 Adopting a decentralized and flexible structure can help OEMs respond to the demands of a "connected" future

Translating the digitization successes of other industries to the automotive industry requires the evolution of the organizational/operating model. We have identified three main needs for the effective transformation of an OEM's traditional organization and operating model.

R&D dedicated to connectivity

Starting with research and development, OEMs' R&D departments currently have little influence on company decision making. Increasing car connectivity will require an R&D apparatus dedicated to connectivity and an approach that is flexible enough to implement faster life cycle updates and accommodate new partnerships with IT players. OEMs need to set up a dedicated R&D structure focused on electronic engineering and connectivity, either within their existing organization or as a separate entity, to coordinate and accelerate research and development on connectivity and digitization topics. This dedicated R&D organization should work closely with the alliances, cooperating parties, and development partners of the OEM and integrate marketing and sales insights regarding new connectivity and digitization-related customer demands and trends. Several OEMs are already acting on this:

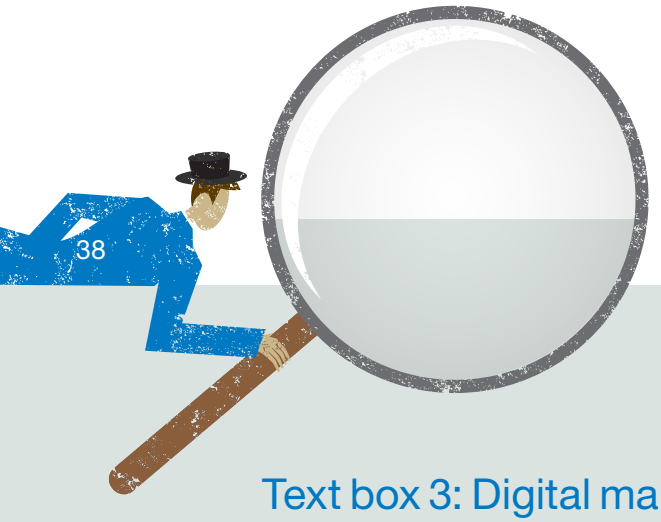
Audi has established a spin-off called Audi Electronics Venture (GmbH) to develop next-generation connectivity services for the VW Group outside the company's core structure. It also invests in and coordinates companies that work on identified key technologies. For example, the company holds a 49 percent share in e.solutions GmbH, which works on a modular infotainment system.[12]

GM's Global Connected Consumer unit is an integrated unit dedicated to OnStar's business operations and all in-vehicle connectivity services and solutions across the GM vehicle brands. The unit includes engineering, IT, marketing, business development, and call center departments. It builds and coordinates the ecosystem for innovation around the connected vehicle by collaborating with carriers, equipment makers, infrastructure providers, and developers, for example, by establishing an application framework for collaborative innovation with third-party developers.[13]

Tier-1 suppliers are also elevating their R&D units to meet the challenge:

Bosch has established Connected Devices and Solutions GmbH, which specializes in the development of sensors and actuators to target the Internet of Things market, including traffic, transportation, and logistics.[14]

Continental has an integrated, dedicated Infotainment and Connectivity business unit within its interior division, which also fosters multiple external partnerships, for example, with Google, IBM, and Cisco systems.[15]



Text box 3: Digital marketing

The rise of mobile technologies and social media is redefining interaction and communication patterns, altering customer behavior as a result. These trends are also impacting automotive OEMs. In line with the findings of McKinsey's Consumer Survey 2014, McKinsey's "Innovating automotive retail" report underlines the increasing importance of the digital experience for new-car buyers, leading to substantial changes of the automotive retail landscape.

According to the "Innovating automotive retail" report, over 80 percent of car buyers surveyed across the US, Europe, and China use online sources in the early steps of their decision making process and more than one-third would consider buying a car online. Furthermore, new-car buyers in the US, the UK, and Germany say they are very open to new types of digital features that enhance their decision and experience journey: 54 percent say yes to a virtual online store, 44 percent to virtual online test drives, and 43 percent to mobile apps.

The increasing importance of online channels challenges the traditional dealership model. First, as customers become better informed and the car becomes more technologically complex, the demands on the skill and knowledge of the sales and service staff will become greater. In response to this trend, one manufacturer decided to mimic the Apple store's Genius bar. Their so-called "product geniuses" are dedicated sales staff with particular expertise on digital features, and ready to help customers on questions not easily answered by a Web search. Second, as showroom visits continue to decline, the dealer network will need to transform into a multi-format sales channel that combines the opportunities of the online world with the traditional dealership channel. Undifferentiated dealerships will potentially shift to a landscape of much more specialized formats, deciding which part of the customer decision and experience journey they want to focus on: brand awareness building and messaging; product experience; sales transactions; or parts and service. Examples are the "brand experience center" that exhibits selected flagship products complemented by interactive stations with product info that visitors can access via their smartphones; or the "test drive center" that enhances its test-drive fleet with on-board computers asking for feedback based on situations during the test drive, enables on the spot purchases, and offers tailored after-sales services.

The transformation of the automotive retail format should be aligned with the overall connectivity service landscape of the OEM, and requires a more sophisticated data management system that integrates existing data from OEM and dealership databases, big "social" data, and data from the connected car.

Upgraded M&S capabilities

Regarding the marketing and sales organization, a capabilities upgrade will be necessary. The upgrade will need to have the insights-gathering capability to both understand and anticipate customer needs and empower the organization to meet increasing customer demands for digital services/offerings. M&S will also need to consider the benefits of sharing its sales channels with other automotive companies or even players from other industries. While this may at first seem counterintuitive from a competition perspective, it can give OEMs the opportunity to reach a much broader customer group.

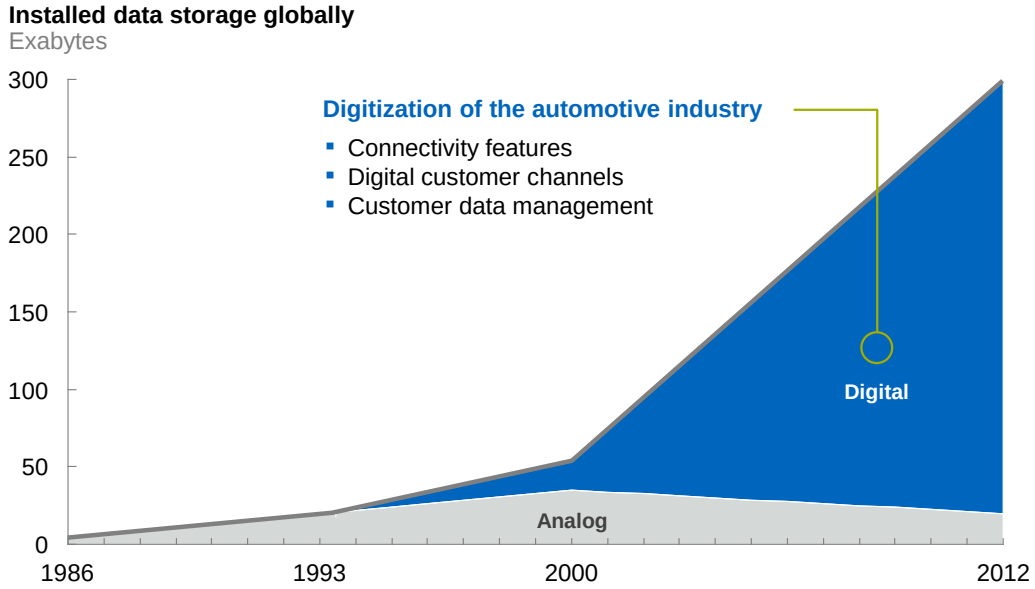
The new M&S organization will have the capacity to leverage digital channels to provide customized user experiences, establish digital platforms for bringing people together, and build communities and gain insights from customer data to constantly improve the value proposition. Mercedes-Benz is among the OEMs already showing visible progress in this area. The carmaker has made its marketing, sales, and after-sales activities easily accessible at any time by bundling them on a digital platform under the new umbrella brand "Mercedes me."

The new brand offers customers a direct channel to current and future Mercedes-Benz service offers, including car sharing (car2go), leasing and financing, direct online interaction with Mercedes-Benz research staff, and car purchases. This allows a consistent customer experience from the first interactions during the new-car development process to maintenance services after the car purchase, thus potentially increasing customer loyalty significantly. Additionally, customer profile data can be leveraged for customized offers to increase up- and cross-selling potential across Mercedes-Benz services.[16]

IT's evolution from cost to profit center

The amount of data stored and processed has grown exponentially since 2000 with a trend towards digitization in the automotive industry as well. OEMs' IT departments will also need to evolve from their organizational positions of cost centers to positions of profit centers, because their growing role in capturing car and customer data sets (Exhibit 16) can make them as important for sales in the near future as dealer networks are today.

Exhibit 16: Storing and processing increasing amounts of data will require OEMs to invest in their IT backbones



SOURCE: Hilbert and López, "The World's Technological Capacity to Store, Communicate, and Compute Information," Science, 2011; McKinsey

In addition to connectivity features, OEM IT backbones need to manage additional digital customer channels and increasing amounts of customer data. Along with the sales opportunities provided by such a massive increase in data collection also comes an increased data security responsibility.

Managing data risk will be just as important as exploiting data potential. Storing and processing the increasing amount of data and building up the required backbone with the necessary security features will require significant resources.

5.2 Upgrading processes and governance can support OEMs' internal functions and external partnerships

To support the transition towards digitization and connectivity-related business models, OEMs will need to put the right processes and governance in place:

Product development/update processes. The overall product and vehicle development processes, currently with lengths of up to five years from concept to start of production, need to be significantly shortened in order to continuously meet the latest customer demands on car connectivity, which are subject to much shorter development cycles.

This demands a highly flexible concept of all connectivity-related and digital modules, both for hard- and software, at the beginning of a vehicle development project. The life cycle update process – for example, mid-life cycle updates – will need to move towards higher frequencies. In addition, a flexible concept will allow for regular and unexpected changes. It is important to avoid unnecessary interfaces between different departments, speed up processes, and build up expert competencies that go beyond research within the company. Furthermore, constant renewal of research teams should be promoted to establish networks in the organization.

Internal organization and external partner coordination. OEMs need to install a central governance body that not only facilitates the coordination of their R&D, M&S, and IT activities with all external stakeholders, such as suppliers, but also with all partners and stakeholders in alliances, and those they are working in cooperation with. Again, the decision making process for vehicle projects will need to have interfaces for cross-company, or even cross-industry decision making that takes place over the course of vehicle development. GM, for instance, has established a framework for collaboration with third-party developers that allows for the codevelopment of high-potential applications based on customer and market insights from GM's marketing department.[17]

Controlling processes. Controlling processes need to expand from vehicle project logic towards the integration of new cross-vehicle project revenues and costs from connectivity.

With the appropriate processes and a less centralized and more nimble governance structure, OEMs can maximize the effectiveness of the capacity upgrades in their departments and flexibly adapt to the quickly changing connectivity landscape.

5.3 Industry standards and partnerships would likely be helpful to OEMs

Innovations across the control points mentioned above raise the need for substantial investments in product development to stay competitive. At the same time, there are elements that don't differentiate single OEMs and represent an ecosystem game with high entry barriers and strong network effects.

For instance, although an underlying operating system does not necessarily affect the user interface, a certain scale is a prerequisite to attract a vibrant developer community and in turn offer an attractive app portfolio to customers. In regard to these elements, industry standards, partnerships, and even industry-wide cooperation can help lower R&D investment and free up OEMs' management attention to focus on critical efforts.

5.4 OEMs can learn from other industries that have already mastered the challenges of digitization

OEMs can learn from other industries already further down the path of managing the digital disruption. Industries that have been famously turned upside down by digitization include telecommunications, photography, personal computing, and video entertainment. Drawing on case studies of these industries, we have identified strategic moves that companies can pursue to shape (or at least fast follow) the adoption curve.

1. Focus on anticipated or developing customer priorities rather than relying on current unique selling proposition. After Apple introduced the iPhone in 2007, some handset players held on to hardware-based keyboard designs. Samsung, on the other hand, quickly adapted to developing customer preferences, adopting a fast-follower strategy and additionally targeting customer segments below the premium segment that, at this point, were not primarily served by Apple's iPhone.[18]

2. Treat your IT organization like a profit center instead of just using it as a support unit. Similarly, in 1999, Netflix launched a subscription DVD rental service using the Internet as a purchase medium, and mail as a distribution channel. At the time, Blockbuster was the dominant player in the US video rental market, with "brick and mortar" rental stores present in nearly every major neighborhood. Instead of elevating its own IT backbone and moving into the digital space, Blockbuster stuck to its traditional distribution channel and business model. When Blockbuster finally went online in 2004, it could not catch up to the established players and finally filed bankruptcy in 2010. Netflix, however, identified new opportunities when Internet speed increased significantly. In 2010, by upgrading its IT backbone, Netflix offered a stand-alone streaming service separate from DVD rentals. In that same year, Netflix became the biggest source of Internet traffic in North America during evening hours. By 2013, it had more than 40 million subscribers.[19]

3. Foster (cross-industry) alliances and partnerships instead of acting as a lone fighter. Samsung revised its handset strategy after initially developing a proprietary operating system called Bada for its flagship model in 2010. However, Bada was taken off the market in February 2013 and Samsung has built a successful partnership with Google's Android system since.[20]

If these stories from other industries are any indication, it will be a forward-thinking, active, adaptive, and collaborative approach to growing digitization that helps OEMs thrive as opposed to stumble.

6 Beyond 2020, autonomous driving will very likely trigger an industry-wide wave of disruption

The disruption that began with connected cars will fuel the development of autonomous driving, which according to legal sources can be defined as driving in *"a motor vehicle that uses artificial intelligence, sensors, and global positioning system coordinates to drive itself without the active intervention of a human operator."**

We see (semi)autonomous driving as the next wave in the automotive industry's development and the natural evolution of the connected car. OEMs should align their respective strategies with the trajectory of this technology. Staying mindful of the technology's potential benefits, its probable reach into adjacent industries, and the challenges to full deployment will help OEMs maximize the opportunities and minimize the risks.

6.1 Autonomous driving has potential benefits for individual drivers as well as society as a whole

Autonomous driving will represent a revolution in the way we conceive of personal mobility and have immediate, far-reaching effects in several areas.

Personal/public safety. Last year in the US alone, there were more than 35,200 deaths from car accidents that involved alcohol, drugs, distraction, and/or fatigue. By removing human judgment and human error from the equation, (semi)autonomous driving could significantly reduce the number of accidents and virtually eliminate fatalities.

Insurance rates drop. In addition to its public safety implications, (semi)autonomous driving will also lead to a reduction in insurance rates. As safety increases and the risk of injury and damage decreases, individuals may see their insurance rates drop significantly. US insurers already offer telematics-based discounts of 30 percent to reward safer driving, and ADAS may likely further reduce insurance costs.

Time efficiency. By eliminating the need to steer the vehicle, (semi)autonomous driving will add about an hour of available time to each driver's day. Many drivers may choose to engage in leisure or entertainment activities during this time. Others may utilize the time for work-related activities like reading e-mails or video conferencing, which will translate into a 10 to 15 percent productivity increase (based on a working day of approximately 8 hours). Improvements to traffic flow are also likely, leading to fewer traffic jams, optimized travel speeds, and less overall time spent in the car.

Independent mobility. Given the level of skill, reflex, and agility required to safely operate conventional vehicles, many nondrivers – such as elderly, under-aged, or disabled people – are either dependent on others for their transportation needs or simply unable to participate as actively in their own lives as they would like. Autonomous driving requires much less, turning the "driver" into more of a passenger and can help many groups become more independently mobile.

Social costs. From the perspective of societal effects, (semi)autonomous vehicles will result in the cut back of the public costs of accident prevention and management as well as healthcare and other social costs related to car accidents. Furthermore, optimized routing and synchronized driving of (semi)autonomous vehicles will reduce negative externalities caused by vehicle emissions and in the long term lessen investment needs in infrastructure (for example, additional lanes/roads and traffic signs and lights).

* Definition as per state of Nevada Department of Motor Vehicles, July 2011

6.2 Autonomous driving is expected to reach beyond automotive and transform adjacent industries

Beyond personal and societal effects, (semi)autonomous driving will transform car-related industries through new value propositions and business models in the following realms:

Mobility services. A new level of massive-scale car sharing/pooling may evolve with the possibility to call your car to pick you up or with automated vehicles serving in public transportation. This would lead to a change in the ownership model, as people might not need a car of their own anymore.

Marketing and promotion (B2B revenue streams). Freed up time in the car will further increase targeted in-car advertising, sales of CRM data, and new "bonus-as-you-drive-by" business models.

In-car experience (B2C revenue streams). New in-car content/services, both work and entertainment related, will likely increase. Consumer electronics may target the in-car experience to expand their reach (for example, a gaming device incorporating the driving experience).

Logistics/industry services. In the logistics industry, autonomous vehicles, such as the autonomous haulage systems used by Rio Tinto, are already a reality. Automation of delivery and pickup services, for example, automated package and mail delivery and automated garbage pickup, may also become standard one day.

These developments will disrupt society as we know it today. Due to a significant increase in vehicle utility rates and changes in the ownership model, the global car park might see the first decline since its invention. Segments of employees might see their jobs on the line, starting with industry vehicle operators to taxi and bus drivers. Whole industries like car insurance companies may face collapse.

6.3 Consumer, technology, and regulatory constraints will likely challenge the full deployment of (semi)autonomous vehicles

We will witness a heated public debate involving regulators that need to make a move. OEMs should think about their positioning and public appearance in this regard. They also need to consider the eventual full deployment of autonomous driving when creating their nearer-term connected car strategies. During this process they need to look at four key areas:

Technology development and innovation. Both connected cars and (semi)autonomous driving capabilities rely on a set of technologies: cellular connectivity, dedicated short-range communications (DSRC), sensors, and vehicle intelligence/processing power. In order to succeed, OEMs might leverage strategic partnerships for codeveloping technologies and sharing the R&D investment. In this context, transforming the organizational setups will be imperative for coping with the challenges of new partnership models.

High quality map data is not only relevant to the monetization of navigation features in the connected car, but it is also a key strategic asset in realizing (semi)-autonomous driving in the longer term. OEMs need to be aware of possible future market scenarios, which range from a monopoly-like scenario where OEMs are highly dependent on a dominant map market leader, to a "diverse playing field" scenario where OEMs buy existing map players or develop their own map services. Given its potential relevance for saving lives by enabling (semi)autonomous driving, governments might choose to keep the map market open and enforce free access and the exchange of map data, including car-generated data gathered by OEMs. Monitoring the industry and regulatory changes thus becomes critical for OEMs to prevent their being locked out of the market by a dominant map player.

Regulations will deeply affect the (semi)autonomous-driving vehicle market and the distribution of revenue

pools by defining key requirements and critical features that need to be fulfilled. In this context, we have identified three potential regulatory activities, each of which has its own market implications:

- **Restrict or ban the use of certain technologies.** For example, regulators may want to ensure that drivers keep their eyes on the road by banning dashboard screens, similar to the restrictions on handheld mobile phones. This could significantly influence the connectivity disruption of the automotive value chain.

- **Mandate deployment of technologies.** This approach potentially accelerates the adoption of a certain technology. In February 2014, the US Department of Transportation announced that it is in the process of creating regulations that would require all vehicles to be equipped with V2X communications capabilities, allowing the vehicle to communicate with other vehicles (V2V) or with infrastructure (V2I).

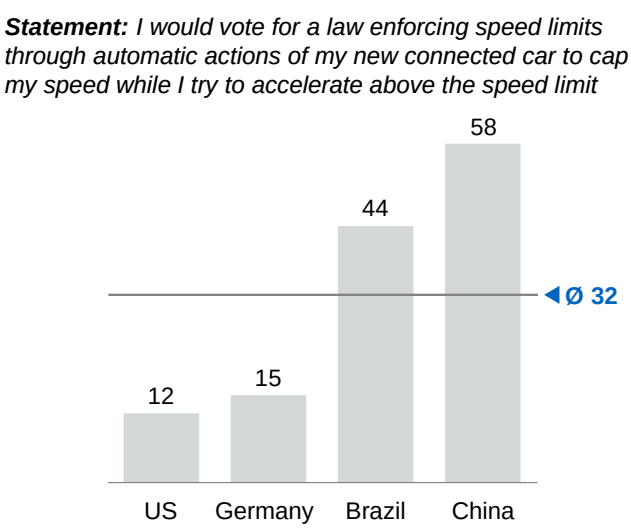
- **Define open technology standards.** By ensuring the compatibility of services and lowering entry barriers, new market entrants will benefit from the provision of standard interfaces for developing their own solutions.

OEMs and suppliers should carefully map and evaluate potential regulatory changes before heading into investment-heavy projects – since some technologies may well get banned while others may see accelerated deployment or stir increased competition.

Customer acceptance. Finally, OEMs face the challenge of educating their potential customers on and convincing them of the benefits of (semi)autonomous driving if they want to ensure successful adoption. In this context, connected cars can foster customers' acceptance of, as well as trust in, related technologies. Information regarding customer preferences for certain connected vehicle features and CRM data should be leveraged to create a bettervalue proposition for the commercialization of (semi)-autonomous driving. According to the findings of the McKinsey Connected Car Consumer Survey 2014, new-car buyers are open to (semi)autonomous driving in general, indicate a clear preference for ADAS functionalities (for example, consumers find adaptive cruise control, which does not require the driver to keep his/her hands on the steering wheel, a lot more useful than basic cruise control), and are even willing to give up car control altogether (Exhibit 17).

Exhibit 17: Overall, consumers even indicate openness to (semi)autonomous driving, but with significant regional differences

Percent of new-car buyers that (strongly) agree with the statement



SOURCE: McKinsey Connected Car Consumer Survey 2014

Conclusion

From current Internet-based infotainment systems to more advanced driver assistance systems in the medium term to, ultimately, fully autonomous driving, the trajectory of the technology-enabled car points towards ever greater connectivity. The automotive industry's traditional players – along with a growing number of companies that are finding new opportunities in automotive – will need to anticipate the shifts to the profit pool that connectivity will likely drive as it increasingly disrupts the value chain.

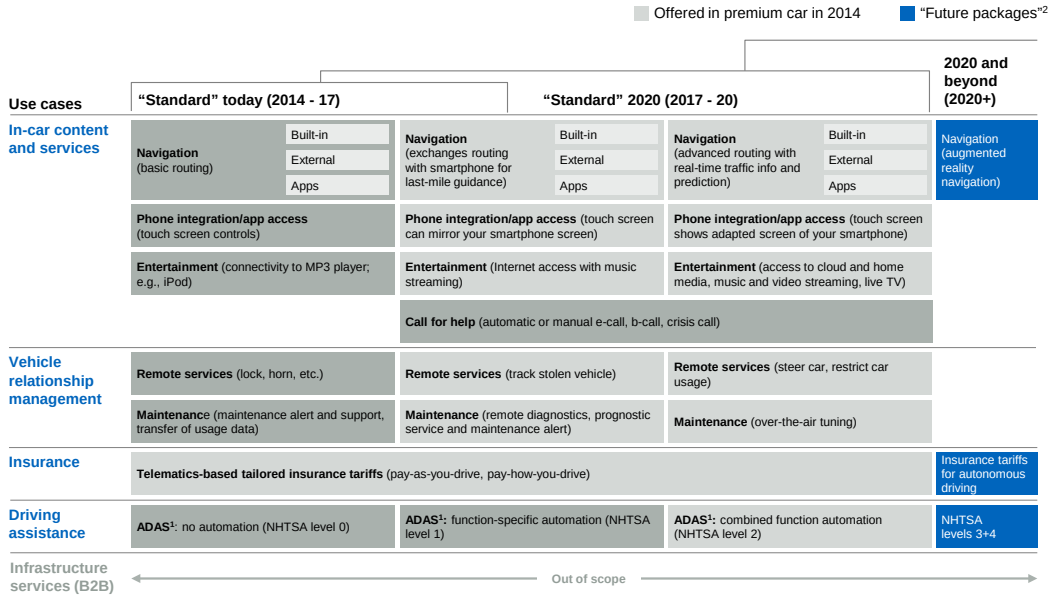
As the car's overall life cycle value is likely to remain constant, it is even more important that businesses with a stake in the game take action now. In particular, OEMs and suppliers will need to defend their current shares and move decisively in the areas where they can play a significant role in connectivity. Insurance, telecoms, and digital players will likely find themselves partnering with OEMs in some way or the other. The degree to which traditional players will be able to hold on to their pieces of the automotive pie, and to which players new to the industry can stake a claim in connectivity depends on how well they are able to establish control points.

Appendix: McKinsey's Connected Car Market Model methodology

McKinsey analyzed the connected car market and developed a market model to define the global automotive market for noncommercial light vehicles. Overall, the market model follows a three-step logic:

Step 1: Defining connectivity. The market model is based on detailed driver trees and feature bundles for each of the 7 distinct connectivity categories, which are: navigation, phone integration/app access, entertainment, remote services, maintenance, insurance, and ADAS (Exhibit 18). For each application/service, we determined demand drivers (including assumptions based on publicly available information) along a good-better-best-futuristic logic. We also have separate assumptions for recurring/usage-based revenues.

Exhibit 18: Definition of connectivity – 4 use cases and 7 distinct categories



1 Advanced driver assistance systems
2 Advanced/future packages include all features of less advanced packages

SOURCE: McKinsey

Step 2: Tailoring to market and segment specifics. We defined four core markets (Brazil, China, Germany, and the US) and three representative car segments (premium, mid, and entry). We then forecasted price developments and adoption rates for each feature bundle based on local primary data, internal knowledge (e.g., McKinsey's Connected Car Consumer Survey) and external research reports (e.g., iSuppli).

Step 3: Aggregating to industry view. Based on the model assumptions for a German premium car, we extrapolated the data to other car segments and automotive regional markets, respectively, to derive global life cycle revenues. Based on the SBD connected car sales forecast, we indexed different adoption speeds per country and segment, calculated industry life cycle revenues for 2014 and 2020, as well as annual revenues from 2014 until 2020, and then (based on IHS new-car sales/existing car parc figures) aggregated the numbers to derive the global connected car revenue pool.

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